# Studies on Diversity of Algae and utilization of BGA as Biofertilizer for sustainable Agriculture and Economic Development.

A Synopsis Submitted to

**Swami Ramanand Teerth Marathwada University, Nanded**

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Under the Faculty of

**Science and Technology**

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**A] Title of the proposed Research**

**"Studies on Diversity of Algae and utilization of BGA as Biofertilizer for sustainable Agriculture and Economic Development."**

**B] Introduction:**

Algae have been the object of little applied research because they do not cause as many problems for mankind as do bacteria and fungi, but in future this situation is likely to change as human and algae interact more often in desirable and undesirable ways. Algae play significant ecological role and are being extensively used as indicator of water pollution because they are natural inhabitants of water, now a days limnological and hydro biological studies have attracted by many workers. Algae are the large and diverse group of plant kingdom comprising simple, typically autotrophic organisms ranging from unicellular to multicellular forms. It is the Photosynthetic form of life found abundant in aquatic and in terrestrial ecosystem of nature. They are found in variety of habitats such as fresh water, marine water, on snow, on rocks, on or in soil and also found on the bark of trees. It is well known fact that algae with help of pigment complex and in the presence of carbon dioxide and water convert effectively solar energy into biochemical energy.

India has a very rich and diversified algal flora. In present century great advances have been made in the investigations of fresh water algae, marine algae, atmospheric micro algae and soil algae in many parts of the world and particular attention has been paid to their taxonomy, ecology and their applied aspects.

They being prototroph are capable of chief food suppliers for most of the small aquatic animals, which in turn are consumed by bigger animals, this forms basic food chain in any aquatic ecosystems and are large number of such food chains are inter linked to form food web, for such web algae serve as chief source of food.

Algae are important members of plant world and several of them are significant to man in many ways. They are beneficial in the field of agriculture, industry, medicine science, space research. Bio-diesel production and bio-remediation. They gain importance in the modern time not only as an alternative potential source of protein for man but also as the primary source of food for aquatic animals. Algae are also considered as rich source of fats, vitamins, minerals and antimicrobial compounds. It was also observed that the algae are found to be stimulatory for the seed germination, plant growth and development.

The algae are the simplest members of plant kingdom, and the blue green algae are the simplest of algae. They have considerable and increasing economic importance. Blue green algae were probably the chief primary producers of organic matter and the first organisms to release elemental oxygen ($O_2$) into primitive atmosphere, which was until then free from $O_2$. Thus blue greens were most probably responsible for the major evolutionary transformation leading to the development to aerobic metabolism and to the subsequent rise of higher plants and animal forms. Blue green algae in literature commonly called as cyanophyta, myxophyta, cyanochloronta, cyanobacteria, and blue green bacteria. The majority of blue greens are aerobic photoautotrophs, their life processes requires only oxygen, light and inorganic substances. Blue greens can grow in full sunlight and in almost complete darkness; they are often the first plants to colonize bare areas of rock and soil, as an example of subsequent to cataclysmic volcanic explosion at Krakatoa, Indonesia 1883. At the onset of adverse environmental conditions, blue greens can develop a modified cell, called as akinet contains large reserves of carbohydrates and owing to their density and lack of gas vesicles, eventually settle to the lake bottom. They can tolerate adverse conditions like complying drying or the cold winter temperatures, and as a consequence, akinetes serve as seed for the growth of juvenile filaments when favorable conditions returns.

Review of literature reveals that, studies on algal taxonomy, biodiversity in abroad and in India have been done extensively by many research workers. In Maharashtra tremendous work has been done on algal taxonomy by various workers, but in Marathwada region of Maharashtra except very few reports very rare attention has been paid, although the environmental and climatic conditions of the Marathwada region are most suitable to grow algae luxuriantly and in diverse form.

**C] Origin of Research Problem:**

The economy of India thrives on agriculture, the most practiced occupation in the country. The agricultural fertilizers are essential to enhance proper growth and crop yield. The Indian farmers have been using the chemical fertilizers recently for quick and better yield. But these chemical fertilizers endanger ecosystem, soil, and plants, human and animal lives. In contrast, naturally grown blue green algae as bio fertilizers not only give better yield but are also harmless to humans.

Agriculture alters the natural cycling of nutrients in soil. Intensive cultivation and harvesting of crops for human or animal consumption can effectively deplete the soil of nutrients. In order to maintain the soil fertility for sufficient crop yields, soil amendments are typically required.

In the past, Indian farmers nourished their fields with animal manure, charcoal, ash and lime ($CaCo_3$) to improve the soil fertility. Today use of inorganic chemical fertilizers and organic nutrient sources to enhance soil fertility often results in surplus quantities of primary nutrients.

Chemically enhanced productivity has depleted the natural resource base for sustainable agricultural growth. Earlier technology has disturbed the biological composition, which might have lasting adverse impact. Unless the disturbed natural resource base equilibrium is restored, sustainable agricultural growth with a competitive edge will not be possible. To increase agricultural production, now it becomes necessary to look over blue green algae as bio fertilizers.

**D] Review of literature including National and International status :**

In 1990, The Department of Biotechnology, Govt. of India, New Delhi established four major centers in country for acceleration and extension of work on algal bio fertilizers, the program was launched under, "Technology Development and Demonstration Projects on Cyanobacterial Bio fertilizers" in Uttar Pradesh (Lucknow), Tamil Nadu (Madurai), West Bengal (Kolkata) and New Delhi. The main objectives of program were:-

1) To develop low cost indigenous technology for mass production of Blue Green Algae.

2) To isolate regional specific fast growing and better nitrogen fixing strains.

3) To develop starter inoculums.

4) To demonstrate the farmers in field and

5) To study the benefits as both Economy and Ecology.

As a result of these studies, Cyanobacterial bio fertilizers were found very useful, especially for small and marginal farmers of the country with the view point of both economy and ecology. (Venkataraman, 1933).

The role of blue green algae in paddy fields was realized by Singh (1961). In water logging conditions, the cyanobacteria multiply, fix atmospheric nitrogen and release it into surroundings in the form of amino acids, proteins and other growth promoting substances (Stewart, 1970). Recent work done at Central Rice Research Institute (Cuttack), Indian Council of Agricultural Research (I.C.A.R.) New Delhi, Centre of Advanced Study in Botany at Banaras Hindu University (B.H.U.) Varanasi.

Japanese workers Watanabe and co-workers (1961) who developed techniques for mass cultivation of blue green algae to be worked as bio fertilizer in paddy fields. Venkataraman (1969) coined the term alganization to denote the process of application of blue green algal culture in field of Paddy as bio fertilizer. He initiated algalization technology in India unto farmer level who holds small lands. At present algalization (blue green algae as bio fertilizer) is being followed in Tamil Nadu, Uttar Pradesh, Andhra Pradesh, and also tried in Karnataka and Jammu Kashmir. Algalization is also being practiced in Abroad as in China, Egypt, and Philippines etc.

Since historical period the algae are used as food, fodder and fertilizer. The algae are known to contain different bioactive compounds. It is observed that several algae have stimulatory effects on seed germination and plant growth. The bioactive compounds present in algae have antimicrobial properties. The biochemical which is present in algae improves seed germination, seedlings development and increases plant tolerance to environmental stresses. The work on algal extract started in India by Gupta (1964).He observed, accelerated germination in paddy seeds treated with algal extracts. The algae contains high percentage of macronutrients and amino acids (Fouly et.al.1992 and Mahmood 2001).The bioactive compounds present in algae enhances all the physiological reactions that leads to good growth (Fayza and Zenaib,2008).

## E] Aims and Objectives of the Proposed Research:

The study area was explored by keeping in mind the following objectives. To study systematically algal flora of pools, ponds, puddles, cisterns, talaos, dams, polluted water passages, streamlets, streams, rivers, industrial waste, moist soils of Latur district in Maharashtra.

1. To study floating, planktonic, submerged and attached epiphytic algae.
2. To study the classwise percentage contribution of algal flora.
3. To study the seasonal fluctuations of algal flora.
4. To study the habitat wise analysis of algal flora.
5. Preparation of algal extracts in different solvents and to study the effect of extracts on seed germination, plant growth and development of (Soybean, Green gram, Black gram, Bengal gram, and Pigeon pea) by petriplate culture method.

**F] Research Hypothesis-**

Review of literature reveals that, studies on algal taxonomy in abroad and in India have been done extensively by many research workers. In Maharashtra tremendous work has been done on algal taxonomy by various workers. In Marathwada region of Maharashtra except few reports (Ashtekar 1980, Kamble 2008, Andhale 2008, Talekar 2009) very rare attention has been paid towards algal taxonomy, although the climatic conditions of Marathwada region are most suitable to grow algae luxuriantly and in diverse form, therefore to fulfil this lacuna, it has been decided to work on algal diversity of Latur district in Marathwada region of Maharashtra.

Following points explains hypothesis of proposed research work:

Aalgal diversity study will enrich the knowledge of algal flora of fresh water habitats of Maharashtra.

1. Seasonal variation study will gives an exact idea about dominance of blue greens at particular season.
2. More than 400 species belonging to different genera will be found.
3. Algal forms will decrease as the water flows with addition of wastes. During rainy season filamentous algae will show dominant growth.
4. Algal bloom study reveals eutrophication of water bodies.
5. Proposed research work will accelerate the algalization.
6. Algalization will increase crop yield by 10-20%
7. Algalization will helps to replace chemical fertilizers and restore natural soil fertility.
8. Algalization will provide protection against drought and soil borne diseases.

G] **Materials and Methodology**:

**i) General Geography and Climatology**:

The Latur district is one of the most developing district of Marathwada region of Maharashtra state. The exact location of Latur district is situated on the Balaghat plateau 540 to 638 meters from the mean sea level, the district is located between 17052' North to 18051' North and 76018' East to 79012' East in the Deccan plateau. The district is bounded by Nanded district to East Osmanabad district to South West; Beed district to North West; Parbhani district to North and Andhra Pradesh and Karnataka states to the South East. The average rainfall in the district is 600 to 800mm, it is usually during the monsoon months from July to October.The moderate temperature is mainly observed here. The rain fall is unpredictable in the tune with Indian monsoon. Summers here begin from early March to July. Summers are dry and hot.The temperature ranges from 24° C to 39° C, though at the peak they may reach 410°C. From November to January, temperature at the peak drops to single digit but usually it is around 130° C to 21.80°C, sometimes low up to 110° C, January to March with moderate temperature. Administratively the districtis divided into three subdivisions namely Latur, Nilanga and Udgir and into 10 talukas and 10 panchayat samitis. There are 945 villages and 786 grampanchayats in the district. Latur city is the administrative head quarter of district.

**ii) Study Area**:

The study area selected for biodiversity of algae lies in 10 tehsils of Latur district in Marathawada region of Maharashtra. The 10 tehsils of Latur district are Udgir, Ahemadpur, Nilanga, Jalkot, Deoni, and Shirur anatpal, Chakur, Ausa, Renapur and Latur. The different sites are selected for collection of algal sample are rivers, pools, ponds, cisterns, talaos, dams, polluted water passages, streams, industrial waste water and moist soils. Manjara is the main river,which flows on the Balaghat plateau along with its tributaries, Terna,Tawarja and Gharni.The other tributaries of Manjara are Manyad,Teru and Lendi which flow on the northern plains. Manjara is the main river its origin is near the Gaukhadi village of Beed district.The river flows from the northern boundaries of the Osmanabad district and cutting across the Latur district goes to Karnataka state. Gharni river has its origin near Wadwal and flows through Chakur taluka.Terna is the main tributary of Manjara which flows on southern

boundry of the Ausa taluka.Tawarja river originates near Murud in Latur taluka and joints the Manjara river at Shivani on Latur –Ausa boundry.Lendi river has its origin in Udgir talukaand flowing through the Ahmedpur taluka and joins the Tiru river in Nanded district.Manyad river takes its origin at Dharmapuri in Beed district and flows through the Ahmedpur taluka into Nanded district.

**iii) Field Work:**

The algal samples will be collected for the period of two years, the collections will be made regularly from selected habitats of Latur district. Acid washed collection bottles will be used for algal collection. Floating, planktonic, submerged, attached epiphytic and moist soil algal samples will be collected. Field notebook will be maintained in which the colour of algae, habit, habitat, pH and dates of collection will be noted.

**iv) Laboratory Work:-**

The algal collections will carefully observed under the microscope, collections will be preserved in 4% formalin and added with 5% glycerin for further investigation. Microphotographs will be taken, the blue green algal diversity study will continue up to first two years. In third year, on the basis of dominance (Alga) algal extracts in different solvents and fine algal powder preparation. usually 5 to 10 random temporary mounts were made from each collection for microscopic observations. Identification of algal taxa and the systems of classification will follow here is substantially that of Desikachary (1959), Smith (1951, 1955), Prescott (1951),Scott and Prescott (1961), Ramnathan (1962),Gonzalves (1981), Iyengar and Desikachary (1981), Sarode and Kamat (1984),Research journals on algae such as Phycos, Phycologia, Indian Journal of Aquatic Biology etc. will also be referred.

**v) Collection of algal material:**

After two years of diversified studies on the basis of dominance, (alga) the blue green alga will be selected for the preparation of algal powder and extracts. and after the selection the algal material will be collected and washed carefully and thoroughly

with fresh water to remove unwanted impurities, attached epiphytes and adhering sand particles and mud.

**i)Preparation of fine powder:**

After washing the algal material will placed on the filter paper sheet in shade for air drying at room temperature for 05 days. The shade drying of algal material is followed by oven drying at $40^0$c for 6 hours. After the drying fine powder will be prepared in grinder and stored in acid washed air tight bottles.

**ii)Preparation of algal extracts in different solvents:**

Algal extracts in different solvents such as cold water, hot water, acetone, methanol, ethanol, chloroform, petroleum ether and toluene will be prepared separately.

**iii) Treatment of seeds with algal extracts:**

To avoid the microbial contamination during germination, the selected seeds will be surface sterilized with 0.1% $HgCl_2$ solution. Surface sterilized seeds will soaked in algal extract for 4 hours .The seeds soaked in sterilized water served as control. After that, they were placed in equidistance on moist germinating paper for germination in sterilized petri plates. The percent germination, root and shoot length of seedling will be measured after 7 days of incubation at room temperature

**H] Details of Collaboration, if needed:**

Department of Biotechnology, College of Computer Science and Information Technology, Latur (M.S.)

**I] Significance of study:**

1. By knowing the local flora of each and every habitat we can enrich the national and global algal flora.
2. The proposed investigation will definitely enrich the knowledge of algal diversity, abundance, seasonal variation, class wise percentage contribution.
3. The concept of algalization will be known to the farmers.

4. BGA as biofertilizers will definitely helps to replace the chemical fertilizers.
5. Use of BGA as bio fertilizer activates the soil biologically.

**J] A tentative chapter scheme-**

Chapter 1- Introduction
Chapter 2- Review of literature
Chapter 3- Materials and Methods
Chapter 4- Taxonomic description
Chapter 5- Experimental result
Chapter 6- Discussion
Chapter 7- Summary
Chapter 8- Bibliography

**K] Year-wise plan of work and targets to be achieved:**

| Year | Target to be achieved |
|---|---|
| I$^{st}$ Year | 1. Extensive literature collection of concerned research proposal by visiting reputed libraries.<br>2. The algal samples will be collected from selected habitats, identifications, microphotographs, habitat wise record.<br>3.Planktonic,floating,submerged,attached epiphytic algae<br>4.Seasonal fluctuation<br>5. Paper publications. |

| | |
|---|---|
| II[nd] Year | 1. The algal samples collection, identification and microphotographs.<br>2. Floating, Planktonic, submerged, attached epiphytic algae<br>3.Seasonal fluctuation<br>4. Paper publications |
| III[rd] Year | 1) Selection of algae for algal powder and extracts preparation on the basis of their dominance.<br>2) The results obtained would be complied to writing and prepare statistical data which could help in preparation of tables, plotting of graphs.<br>3) Preparation of fine algal powder.<br>4) Preparation of algal extracts in different solvents to study the effect on seed germination, plant growth and development of (Soybean, Green gram, Black gram, Bengal gram, Pigeon pea,) by petriplate culture method.<br>5) Submission of Pre Ph.D. synopsis<br>6)Thesis submission |

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